as astonishing to everyone else as they were to Mr. Darwin himself. From a most carefully conducted series of experiments from which every possible source of error seems to have been eliminated, it appears that the absorption by a gland of $\frac{1}{268800}$ of a grain of carbonate of ammonia (this salt producing no effect when absorbed through the root) is sufficient to excite inflection and aggregation of the protoplasm. With nitrate of ammonia a similar effect is produced by the $\frac{1}{691200}$ of a grain; while the incredibly small quantity of $\frac{1}{19760000}$ of a grain of phosphate of ammonia produces a like effect. Mr. Darwin believes that carbonate of ammonia is also absorbed in the gaseous state by the tentacles; but we venture to think that the evidence on this point is not conclusive. In both the experiments which he records the air surrounding the plant was more or less humid, and the effect was much more intense in the one where the air was the dampest, indicating apparently that the inflection was due to the absorption of the extremely soluble gas by the moisture which was in contact with the tentacles. This would also afford an explanation of what he regards as "a curious fact, that some of the closely adjoining tentacles on the same leaf were much, and some apparently not in the least, affected," if we suppose that they were clothed with larger and smaller amounts of moisture. The view that the glands have no power of absorbing gases or effluvia receives confirmation from the failure of the attempt to induce inflection or aggregation by the affixing of particles of meat in close proximity to the tentacles, but without actual contact.

We cannot follow Mr. Darwin through his exhaustive series of experiments on the effects of various solutions of mineral salts, acids, and poisons, on the leaves of *Drosera*. With organic fluids the aggregation of the protoplasm and inflection of the tentacles furnish a most delicate and unerring test of the presence of nitrogen. The effect of inorganic salts and poisons can by no means be inferred from the effect of the same substances on living animals, nor from their chemical affinity. Nine salts of sodium all produced inflection, and were not poisonous except when given in large doses; while seven of the corresponding salts of potassium did not cause inflection, and some of these were poisonous. This corresponds to the statement of Dr. Burdon Sanderson, that sodium salts may be introduced in large quantities into the circulation of mammals without any injurious effects, whilst small doses of potassium salts cause death by suddenly arresting the movements of the heart. Benzoic acid, even when so weak as to be scarcely acid to the taste, acts with great rapidity and is highly poisonous to *Drosera*, although it is without marked effect on the animal economy. The poison of the cobra, on the other hand, so deadly to all animals, is not at all poisonous to *Drosera*, although it causes strong and rapid inflection of the tentacles, and soon discharges all colour from the glands.

The last point of investigation is the mode of transmission and nature of the conducting tissue of the motor impulse from one tentacle to another. It has been already stated that the seat of irritability is limited to the glands themselves and a few of the uppermost cells of the pedicels, the blade of the leaf itself not being sensitive to any stimulant. In order to be conveyed from one tentacle to another, the impulse has therefore to be transmitted down nearly the whole length of the pedicel; and it appears to be conveyed from any single gland or small group of glands through the blade to the other tentacles more readily and effectually in a longitudinal than in a transverse direction. It can be shown that impulses proceeding from a number of glands strengthen one another, spread further, and act on a larger number of tentacles than the impulse from any single gland. The phenomenon already alluded to, of the aggregation of the protoplasm in a tentacle incited indirectly by the irritation of other glands on the leaf—this aggregation advancing not upwards, but downwards, in each tentacle—is spoken of by Mr. Darwin as partaking of the nature of those actions which in the nervous systems of animals are called reflex. The existence of such a phenomenon—of which this is the only known instance in the vegetable kingdom—is one of the most extraordinary points brought out by these investigations. It will be recollected that the transmission of the motor impulse in the sensitive leaves of *Mimosa* is in a precisely opposite direction, travelling upwards from the base to the apex of those pinnæ which are indirectly irritated in consequence of the direct irritation of other pinnæ of the same leaf. The arrangement and direction of the fibro-vascular bundles in the leaves of *Drosera* are shown in Fig. 4; and Mr. Darwin's inquiries were first directed to solve the question whether the impulse was conveyed through the vascular system; but he came to the conclusion that it is not sent, at least exclusively, through the spiral vessels or through the tissue immediately surrounding them. He believes, on the contrary, that the conducting tissue is the parenchyma or cellular tissue of the mesophyll of the leaf; and that it is chiefly delayed by the obstruction offered by the cell-walls through which it has to pass; the transmission of the impulse being indicated by the phenomenon of aggregation of the protoplasm, which is transmitted gradually from cell to cell.

A few other species of *Drosera* were examined, but presented no special phenomena of interest; and the remainder of the volume is occupied by the narrative of researches on other carnivorous plants, a review of which we must defer to a future number.

ALFRED W. BENNETT

(*To be continued.*)

PERCY'S METALLURGY

Metallurgy: Introduction, Refractory Materials and Fuel. By John Percy, M.D., F.R.S. (London: J. Murray, 1875).

THIS valuable work is not merely a new edition of the volume previously published by its distinguished author, for it contains more than 350 pages of fresh matter, and several articles on subjects which were not treated of originally. Dr. Percy's "Metallurgy" is so well known as the standard book in this country that it may be well to indicate as succinctly as possible the differences between the present volume and the portion of the one published in 1861, which was devoted to refractory materials and fuel.

Much information has been added to the section which treats of the physical properties of metals. Thus a general but comprehensive view of the subject of Elasticity is given, with ample references to the works of Wertheim, Kupffer, Styffe, and others. Tresca's experiments on the flow of metals are also briefly described, and "Tensile strength" has received due attention. Graham's experiments on the occlusion of gases by metals are described at some length.

The matter relating to the composition, fusibility, and character of slags, has been re-arranged.

As plumbago crucibles are now so extensively used, the question of the suitability of different kinds of graphite for their manufacture has become of much importance. A valuable table of analyses of graphite of various qualities from different localities is therefore given, and the machinery used by Messrs. Morgan in their well-known crucible works is illustrated by excellent drawings. The apparatus devised by Ste. Claire Deville for obtaining high temperatures is now frequently employed in laboratories, and the description of the methods of making the crucibles of carbon, lime, magnesia, alumina, and bauxite will be of much service. Deville's blast furnace is described, but we could have wished that, in the interests of metallurgical research, some account had been given in this place of the oxyhydrogen blowpipe, and of the apparatus by means of which he melted platinum.

Care has been taken to collect the recently discovered facts relative to the calorific power and calorific intensity of fuel, and these are specially considered with reference to furnace temperatures. The section devoted to Pyrometry is excellent, and Weinholt's classification of the principles on which the instruments have been constructed has been adopted.

The question of the utilisation of peat and of the possibility of substituting it for coal in metallurgical and other manufacturing processes, has of late particularly engaged public attention in this country. Dr. Percy has therefore collected "such evidence as may enable the reader to arrive at a satisfactory judgment on that question," and forty-six pages are devoted to the consideration of cutting peat, together with its mechanical treatment, condensation, and desiccation. We may quote some of Dr. Percy's general conclusions as to its use as fuel. He observes that, "so far as the suitability of peat for metallurgical purposes is concerned, we may not unreasonably conclude that it could be widely substituted for coal with success;" but he states as his conviction that peat can only compete with coal in countries where the cost of production and carriage of peat is relatively very low and the price of coal is relatively very high.

More than 200 analyses of coal from various parts of the world are given, and we may mention as an indication of the care which has been taken to render the section devoted to coal as complete as possible, that Von Meyer's recent investigations as to the nature of the gases disengaged from certain varieties, and Fleck's table showing the action of weathering on the chemical composition of coal, are recorded at some length. Valuable remarks as to the various sources of error in the analysis of coal are given, but we venture to think that students would have been grateful for some account of the methods of analysis and details of manipulation.

The author next treats of charcoal, and an account of Dromart's process for charring in circular piles by firing at the bottom has been added to the descriptions of the various processes contained in the former volume. Reference is also made to the methods of preparing brown charcoal and "torrefied wood," and the section concludes with theoretical considerations concerning their use.

In the new matter relative to coke, the various methods of desulphurisation are treated at some length, and, in considering the economic products generated during coking, Dr. Percy gives much evidence as to the working of Pernolet's oven; but he concludes, as in the case of many other metallurgical operations, by pointing out that the evidence as to the advantages of the process "is not a little conflicting." A new article has been added on the preparation of peat-charcoal, with reference to the employment of which the author observes "that as yet the use of peat-charcoal in metallurgical operations in Great Britain is either very restricted or must be kept rigidly secret."

The consideration of one or two questions of practical importance in connection with the subject of fuel is reserved for the conclusion of the volume.

The author, in treating of the preparation of peat for fuel, makes some observations on patents generally which deserve notice. He says: "Should any person of ordinary intelligence be disposed to wade through the dreary specifications of patents relating to the preparation of peat for fuel, he will perceive that frequently the same thing has been patented several times, and that in not a few cases the patentees have displayed astounding ignorance of the subject." He suggests as a remedy that "a tribunal for the administration of patent law" should be established. "The expenses of such a tribunal could be defrayed . . . . out of the large *surplus* income, exceeding 50,000*l.*, arising from the duties and fees paid by patentees." The authority of such a court would doubtless have a very beneficial effect; but we may point out that the sum above named would probably be very materially reduced by its intervention, and that the vigilance and remuneration of the tribunal might each tend to diminish the other. Dr. Percy calls attention to the scheme proposed during the present session by the Lord Chancellor, who suggests the appointment of five additional commissioners of patents, without giving them any remuneration whatever for their services!

Among the illustrations are plans and sections of Ekman's peat kiln, of Echement's pile for making brown charcoal, and at the end of the volume there are nine folding plates, some of them coloured, giving complete working drawings of Siemens' gas producer and regenerative gas reheating furnace, and of Coppée's coke oven, in which even the forms and dimensions of the fire-bricks are shown. The drawings throughout the volume are admirable, and, as is the case in all Dr. Percy's works, are drawn to scale.

We think that it is a matter for congratulation that the author's labours have been devoted to rendering the introduction to Metallurgy as complete as possible, before considering metals not yet touched upon, which would doubtless have been more attractive work. Throughout this, as in former volumes, the slightest aid has been carefully acknowledged, and the relative merits of discoverers are most conscientiously apportioned, in Dr.

Percy's remarks, which are sometimes severe but always impartial.

In viewing the volume in relation to metallurgical science generally, we are reminded of a remark made by Dumas more than twenty years ago: "Les nouvelles substances métalliques ne méritent certes pas l'oubli dans lequel les chimistes les laissent depuis si longtemps." We fear that the words apply with some force to the state of metallurgical *research* at the present day; still, the progress which has been made is very considerable, and this country has good reason to be proud of Dr. Percy's contributions to the literature of the subject.

OUR BOOK SHELF

Sound. By John Tyndall, D.C.L., LL.D., F.R.S., Professor of Natural Philosophy in the Royal Institution of Great Britain. Third Edition. (London: Longman and Co., 1875.)

THE principal addition to this new edition of Dr. Tyndall's work on Sound is an account of the investigation which he has conducted in connection with the Trinity House, and which he treats here under the title, "Researches on the Acoustic Transparency of the Atmosphere, in relation to the question of Fog-signalling." By this investigation, "not only have the practical objects of the inquiry been secured, but a crowd of scientific errors, which for more than a century and a half have surrounded this subject, have been removed, their place being now taken by the sure and certain truth of nature." In his preface Dr. Tyndall remarks on some of the criticisms which have been made on the results of the investigations referred to. It is interesting to learn that the work has been translated into Chinese, and published at the expense of the Government at the moderate price of 20*d.*

Six Lectures on Light, delivered in America in 1872-73. By John Tyndall, D.C.L., F.R.S., &c. Second Edition. (London: Longman and Co., 1875.)

WE are glad to see that these interesting popular lectures, to which we referred during and after their delivery, have reached a second edition; they are well calculated to interest the general reader, and, we have no doubt, have been the means of inducing many to make a systematic study of the subject to which they refer. The principal change in this edition is the omission of Dr. Young's "Reply to the Edinburgh Reviewers," the reprint of which in the first edition, Dr. Tyndall believes, has served the purpose intended. In place of this, a beautifully executed steel engraving of Lawrence's portrait of Young is prefixed to the volume.

The Birds and Seasons of New England. By Wilson Flagg. With Illustrations. (Boston: Osgood and Co. London: Trübner and Co., 1875).

MR. FLAGG is evidently an enthusiastic lover and close observer of nature in all her moods and phases, but this more from the sentimental and poetic than from the scientific point of view. His book consists of a great number of essays on various aspects of nature as manifested in the New England country, the most original being on the songs of the birds of that region. That he must be a very patient and very minute observer is evidenced by the fact that he has actually embodied in musical notation the songs of some of the principal singing birds of New England. We have no means of testing the correctness of Mr. Flagg's interpretation of these singers, but we should think, judging from the very careful observations he has evidently made, that they are generally correct. The work also contains essays on the aspects of nature in the various months of the year, and on such subjects as "The Haunts of Flowers," "Water Scenery," "The Field and the Garden," "Picturesque Animals," "The Flowerless Plants," "Swallows: their Hibernation," "Changes in the Habits of Birds," &c. Mr. Flagg's essays, we must say, are on the whole rather tedious, reminding us often of the tiresome moral essayists of last century, although they frequently contain passages of quite poetic beauty. There is also a sufficient amount of novelty about many of the subjects to add interest to his observations, and many facts are recorded concerning the habits of the New England birds that will give the book some value in the eyes of the naturalist. Those who love a quiet dreamy country life will find much throughout the book to interest them. Mr. Flagg, as we have said, evidently possesses the power of minute observation, and we would recommend him to bring himself abreast of the ornithology, and indeed general natural history, of the day, and carry on his observations from a more scientific point of view, which he can easily do, and still find scope enough for the satisfaction of his sentimentalism; he might thus render substantial service to science. Judging from what he says about the "hibernation" of swallows, he seems to be unaware that anything has been written on the subject of the migration of birds since the days of Gilbert White. Mr. Flagg's essays want the simplicity and naturalness and geniality of the Letters of that minute observer.

The illustrations of New England scenery are beautiful specimens of the heliotype process, and add much to the interest of the work. An index is appended containing both the common and the scientific names of the birds referred to in the work, but why should so carefully "got-up" a book have been printed without a table of contents?

Practical Guide to Carlisle, Gilsland, Roman Wall, and Neighbourhood. By Henry Irwin Jenkinson. Also, *Smaller Practical Guide.* By same author. (London: Edward Stanford, 1875).

MR. JENKINSON has succeeded in accomplishing what he has aimed at; he has written a really "useful, entertaining, and instructive" guide-book to the district indicated in the title. This district, of no very great extent, abounds in varied interest, and to those who desire to visit it we could recommend no more valuable companion than Mr. Jenkinson's "Practical Guide." He has evidently taken pains to make himself personally well acquainted with the localities he describes, and has diligently collected all the historical and other associations which add interest to the various points to be visited. To antiquaries, his "Walk along the Roman Wall from Coast to Coast" will be specially interesting, and with this book in one's hand we could imagine no more interesting and instructive walk for a summer holiday. The difference between the larger and smaller Guide is, that the former contains an additional eighty pages on the Local Names and the Natural History—Geology, Mineralogy, Botany, Entomology, and Ornithology—of the district, which adds to its value from a scientific point of view. Both books contain an excellent map of the county from coast to coast, embracing a distance of several miles on each side of the Roman Wall. We commend the Guide as the best to be had for the district to which it refers.

North Staffordshire Naturalists' Field Club. Annual Addresses, Papers, &c. With Illustrations. (Hanley: William Timmis, 1875.)

THIS club has now been in existence for ten years, and judging from the list of papers read and excursions made, has evidently carried out with creditable faithfulness the